

Technology Opportunity

Self-Referenced Intensity Modulated Fiber Optic Sensing Systems

Fiber optic sensing systems with intensity modulating sensors respond to applied disturbances by altering the intensity of light passing through the sensing elements. The systems are conceptually simple and relatively inexpensive. They do not require coherent sources and single mode fibers. Also, availability of various sensing elements makes it easy to design a sensing system to meet given requirements. However, these systems have a serious drawback which limits their applications in harsh environments. The drawback is their sensitivity to variable losses in sources, detectors, connecting fibers, and connectors. Techniques developed at NASA Lewis Research Center introduce various compensating schemes to reduce these negative effects.

Potential Commercial Uses

- Fiber optic sensing systems for harsh and noisy environments
- Process control instrumentation
- Medical instrumentation
- Fly-by-light instrumentation
- Signal processing of pulses of short duration

Benefits

- Minimizes the effect of noise and variable losses on measurements
- Increases sensitivity and dynamic range
- Employs multimode fibers and connectors and low coherence sources
- Provides flexibility in design to meet particular requirements
- Uses relatively inexpensive components

The Technology

Two compensating schemes developed involve either a pulsed source or a continuously modulated one. A common feature in both schemes is a sensing head of an interferometric configuration which houses an intensity modulating sensing element. The sensing element is incorporated in one of the arms of the interferometric sensing head.

In a system with a pulsed source the initial light pulse is split, a portion of it is sent through the sensing element, and the rest bypasses it. A double pulse results because of a difference in optical paths the two portions of the initial pulse travel in the interferometric sensing head. The pulse that passes through the sensor is a "signal" pulse, and the other one is the "reference." A relative amplitude of these pulses carries information about losses in the sensor that are related to the measured parameter. Also, a triple pulse has been generated similarly; the middle pulse is the "signal" pulse, and the other two are the "reference" pulses. The amplitude to frequency conversion technique in this case permits the tracking of a so called "characteristic" frequency as a function of the measured parameter.

In the other compensating scheme the source is modulated at two radio frequencies such that the signal at one of the two frequencies experiences constructive interference. At the same time the signal at the other frequency undergoes a destructive interference. The ratio of signals at the two frequencies exhibits high sensitivity to changes in the measured parameter (temperature, pressure, etc.). At the same time, this ratio is not sensitive to disturbances outside the sensing head.

The compensating schemes are simple to implement and can accommodate different sensing elements. Various configurations of interferometric sensing heads permit flexibility in the design of the sensing systems.



Options for Commercialization

The NASA Lewis Research Center seeks industrial partners to license and/or commercialize the technology. Some of the technology is patented (Patent Number 4,995,697).

Contact

Ann Heyward, Chief
Commercial Technology Office
NASA Lewis Research Center
Cleveland, OH 44135
Phone: (216) 433-5568
Fax: (216) 433-5012
E-mail: Ibis@lerc.nasa.gov

David Salay, Manager of Client Services
Great Lakes Technology Center (GLITeC)
Phone: (216) 734-0094
Fax: (216) 734-0686
E-mail: salay@battelle.org

Key Words

Fiber optic sensing
Referencing
Intensity modulation



National Aeronautics and
Space Administration
Lewis Research Center